CHAPTER 4 - TRANSPORTATION NETWORKS

INTRODUCTION

This Chapter summarizes the highway, transit, toll, and heavy-duty truck networks used in the Year 2003 Model Validation. The software conversion to TransCAD facilitated a significant improvement to SCAG's Model networks. The traditional stick type networks have been abandoned for a new GIS based network approach. The highway networks used in the Year 2003 Model Validation were built from scratch using aerial photos and the TransCAD software. TransCAD provides enhanced capabilities for network coding, maintenance, and expanded graphic capabilities. In addition, the GIS based database structure allows for an almost unlimited number of attributes and is very flexible. The Year 2003 highway network went through an extensive review to examine network coding accuracy and to insure proper network connectivity. Once complete, the transit network was built directly off the highway network insuring an integrated network approach.

Attributes for the Year 2003 highway network were determined based on the Federal Highway Functional Classification system, SCAG's Highway Inventory and inputs from sub-regional/regional agencies. SCAG conducted an extensive review of the new Highway Network. The new highway network was distributed to interested transportation commissions and Caltrans districts for an extensive review. Several meetings of the Group were conducted to discuss coding conventions and to accept comments. SCAG Modeling staff also performed an extensive review of the highway network using aerial photos to confirm network coding and connectivity. Sensitivity model runs using the new networks were performed and loaded volumes plots were carefully examined to insure proper network flows and connectivity.

The free flow speed and roadway capacity used by trip distribution and assignment were assigned to the network using speed/capacity lookup tables (see Tables 4-1 through 4-6). A summary of the number of links, roadway centerline miles, and number of lane miles in the highway network is provided (see Table 4-7). This information is summarized by county and for the Region as a whole. The four model time periods are defined later in this Chapter.

The transit network is a key input to the mode choice model and is used in the transit trip assignment process. For the transit network, all elements that are used to determine level of service for the mode choice calculations are identified and defined in this Chapter. The various modes (Metrolink, MTA local bus, etc.) in the transit network are also identified. Finally, a summary of the number of transit lines, route miles, and vehicle miles and hours of service represented in the regional transit network, by mode, is presented (see Table 4-10).

HIGHWAY NETWORKS

The highway network was developed and coded utilizing the TransCAD Software system. TtansCAD uses a GIS based network approach which insures geographic accuracy and provides greatly enhanced editing capabilities. Appendix B contains a listing of the variables contained in the TransCAD highway network.

The Year 2003 highway network includes detailed coding of the region's freeway system (mixed-flow lane, auxiliary lane, HOV lane, toll lane, truck lane, etc.) and as well as arterials, major collectors, and some minor collectors. To simulate roadside parking restrictions and to facilitate other lane changes during the day, separate networks were developed for each of the following four modeling time periods:

- A.M peak period (6:00 A.M. to 9:00 A.M.)
- P.M peak period (3:00 P.M. to 7:00 P.M.)
- Midday period (9:00 A.M. to 3:00 P.M.)
- Night period (7:00 P.M. to 6:00 A.M.)

Facility Types

Facility type (FT) definitions used in SCAG's Year 2003 highway networks are generally consistent with the Federal Functional Highway Classification system. Listed below are the major categories used for defining Facility Type. Appendix B has the full listing of facility types used in coding the detailed TransCAD Network.

Facility Types (see Appendix B for complete listing of Facility Types):

- FT 10 - Freeways
- FT 20 - HOV
- FT 30 - Expressway/Parkway
- FT 40 - Principal Arterial
- FT 50 - Minor Arterial
- FT 60 - Major Collector
- FT 70 - Minor Collector
- FT 80 - Ramps
- FT 90 - Truck lanes
- FT 100 - Centroid connector

Area Types

Area type (AT) used in the highway networks were prepared based on development density (population and employment density) and land use characteristics.

- AT 1 - Core
- AT 2 - Central Business District
- AT 3 - Urban Business District

- AT 4 - Urban
- AT 5 - Suburban
- AT 6 - Rural
- AT 7 - Mountain

Free Flow Speeds and Capacities

Free-flow speeds and capacities assigned to each link in the network are presented in Table 4-1 through Table 4-6, considering the posted speed, facility type and area type of each link.

Table 4-1

YEAR 2003 FREEWAY/EXPRESSWAY FREE FLOW SPEED

	AT1	AT2	AT3	AT4	AT5	AT6	AT7
Freeway	PS	PS	PS	PS	PS	PS	PS
HOV	PS	PS	PS	PS	PS	PS	PS
Expressway (Limited Access)	PS	PS	PS	PS	PS	PS	PS
Fwy-Fwy Connector	45	45	50	50	55	55	55
On-Ramp (peak)	15	15	20	20	30	35	35
On-Ramp (off-peak)	25	25	30	30	35	35	35
Off-Ramp	25	25	30	30	35	35	35

Notes:
AT1: Core
AT2: Central Business District
AT3: Urban Business District
AT4: Urban
AT5: Suburban
AT6: Rural
AT7: Mountain
PS = Posted Speed

Table 4-2

YEAR 2003 ARTERIAL FREE FLOW SPEED

Posted Speed	AT1	AT2	AT3	AT4	AT5	AT6	AT7
	-- Principal Arterial --						
20	21	22	22	24	25	27	27
25	23	24	25	27	28	31	31
30	25	26	27	29	31	34	34
35	27	28	29	32	35	38	38
40	28	30	32	34	37	41	41
45	30	32	34	37	40	45	45
50	33	35	37	41	45	51	51
55	34	38	39	44	49	56	56
	-- Minor Arterial --						
20	19	20	21	23	24	27	27
25	21	22	23	25	27	30	30
30	22	24	25	28	30	34	34
35	24	26	27	30	33	37	37
40	25	28	29	32	36	41	41
45	27	29	31	34	38	44	44
50	29	32	33	38	43	50	50
55	30	33	35	40	46	55	55
	-- Major Collector --						
20	17	18	19	21	23	26	26
25	18	20	21	23	26	30	30
30	19	21	22	25	28	33	33
35	20	22	24	27	31	36	36
40	21	24	25	28	33	39	39
45	22	25	26	30	35	43	43
50	23	27	28	33	39	48	48
55	24	28	30	35	42	52	52

Notes: ***Add 4% for divided streets***

AT1: Core
AT2: Central Business District
AT3: Urban Business District
AT4: Urban
AT5: Suburban
AT6: Rural
AT7: Mountain

Table 4-3

YEAR 2003 ARTERIAL/EXPRESSWAY CAPACITY (Signal Spacing < 2 miles)

On\Crossing	2-Lane	4-Lane	6-Lane	8-Lane
	-- AT1_Core --			
2-Lane	475	425	375	375
4-Lane	650	600	500	500
6-Lane	825	700	600	550
8-Lane	825	700	650	600
	-- AT2_Central Business District --			
2-Lane	500	450	400	400
4-Lane	675	625	500	500
6-Lane	850	725	625	575
8-Lane	850	725	675	625
	-- AT3_Urban Business District --			
2-Lane	525	450	400	400
4-Lane	700	625	525	525
6-Lane	875	750	650	600
8-Lane	875	750	700	650
	-- AT4_Urban --			
2-Lane	550	475	425	425
4-Lane	750	675	550	550
6-Lane	925	800	675	625
8-Lane	925	800	750	675
	-- AT5_Suburban --			
2-Lane	575	500	425	425
4-Lane	750	675	550	550
6-Lane	925	800	700	625
8-Lane	925	800	750	700
	-- AT6_Rural --			
2-Lane	575	500	425	425
4-Lane	750	675	550	550
6-Lane	925	800	700	625
8-Lane	925	800	750	700
	-- AT7_Mountain --			
2-Lane	575	500	425	425
4-Lane	750	675	550	550
6-Lane	925	800	700	625
8-Lane	925	800	750	700

Notes: ***Capacities are in passenger car per lane per hour (pcplph).***
Lanes are mid-block 2-way lanes.
Add 20% for one-way streets.
Add 5% for divided streets.

Table4-4

YEAR 2003 ARTERIAL/EXPRESSWAY CAPACITY (Signal Spacing >=2 miles)

TYPE	POSTED SPEED	CAPACITY (PER LANE)
Multilane Highway	45 50 55 60	1,600 1,700 1,800 1,900
2-lane Highway		1,400

Table 4-5

YEAR 2003 FREEWAY CAPACITY

Type	Posted Speed (mile per hour)	Capacity (passenger car per lane per hour)
Freeway/HOV	55 and below 60 and 65 70 and above	1,900 2,000 2,100
Freeway-Freeway Connector	40 and below 45 50 55 60 and above	1,400 1,600 1,700 1,800 1,900
Auxiliary Lane		1,000

Table 4-6

YEAR 2003 RAMP CAPACITY

	AT1	AT2	AT3	AT4	AT5	AT6	AT7
On-Ramp (first lane)	720	720	720	720	1,400	1,400	1,400
On-Ramp (additional lane)	480	480	480	480	600	1,400	1,400
On-Ramp (off-peak)	1,300	1,300	1,300	1,300	1,400	1,400	1,400

Notes: Use arterial/expressway capacity estimation procedure for Off-ramps.

AT1: Core
AT2: Central Business District
AT3: Urban Business District
AT4: Urban
AT5: Suburban
AT6: Rural
AT7: Mountain

Toll Roads

The Year 2003 highway network includes all toll facilities. Toll facilities include the SR-91 Express Lanes and the San Joaquin Eastern and Foothill Toll Roads developed by the Transportation Corridor Agency (TCA). All toll facilities are located in Orange County.

Heavy Duty Truck Designation

The Year 2003 highway network incorporates special network coding that allows for heavy-duty trucks to be converted into Passenger Car Equivalents (PCEs). This enables the Model to account for the effects of trucks on link capacity in the mixed flow vehicle traffic stream. The highway network also includes coding to identify truck only lanes and truck climbing lanes.

Freeway Lane Type

For the Regional Transportation Modeling purpose, the Year 2003 Model includes a detail coding of the region's freeway system. Freeway lanes are identified according to the following 3 lane types:

- Type 1 Lane (Through Lane) includes continuous freeway lanes that extend more than 2 miles and that pass through at least one interchange,
- Type 2 Lane (Auxiliary lane of Capacity Significance) includes auxiliary freeway lanes that extend more than one mile or that extend from interchange to interchange,
- Type 3 Lane (Other Freeway Lane) includes all types of acceleration and deceleration lanes or freeway widening that do not satisfy the conditions for Type 1 and Type 2 lane classification.

Year 2003 Highway Network Summary

Figures 4-1 through 4-3 depict the Year 2003 highway network by facility types and area types. Additionally, Table 4-7 summarizes the Year 2003 Highway Network. The network summary is accomplished by tallying the number of highway facility route and lane-miles represented in the network, for each county and facility type. A route mile summary (see Table 4-7) includes both directions of travel, even if the section of roadway is represented by two separate one-way links in the coded network.

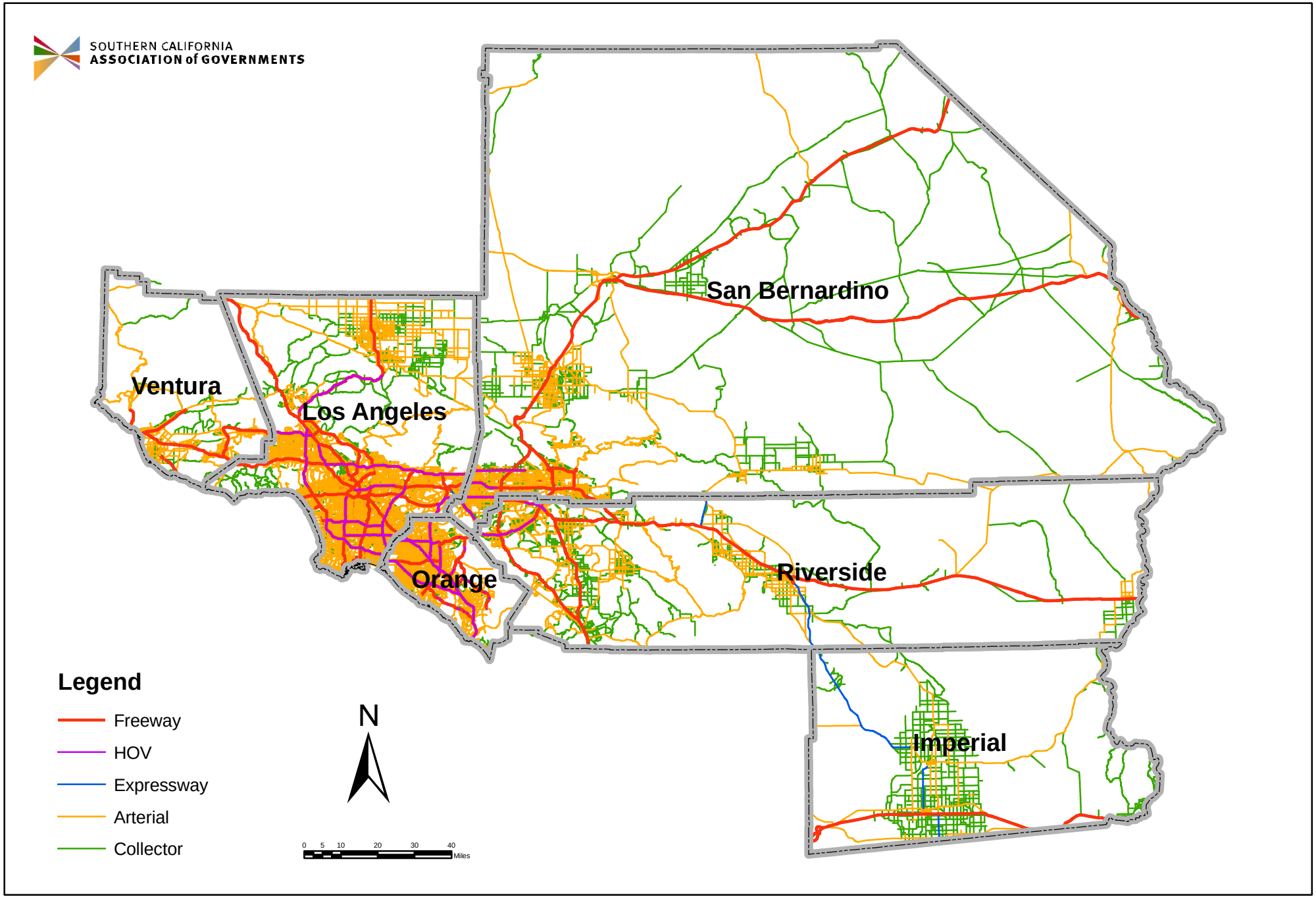

FIGURE 4-1
YEAR 2003 NETWORK BY FACILITY TYPE

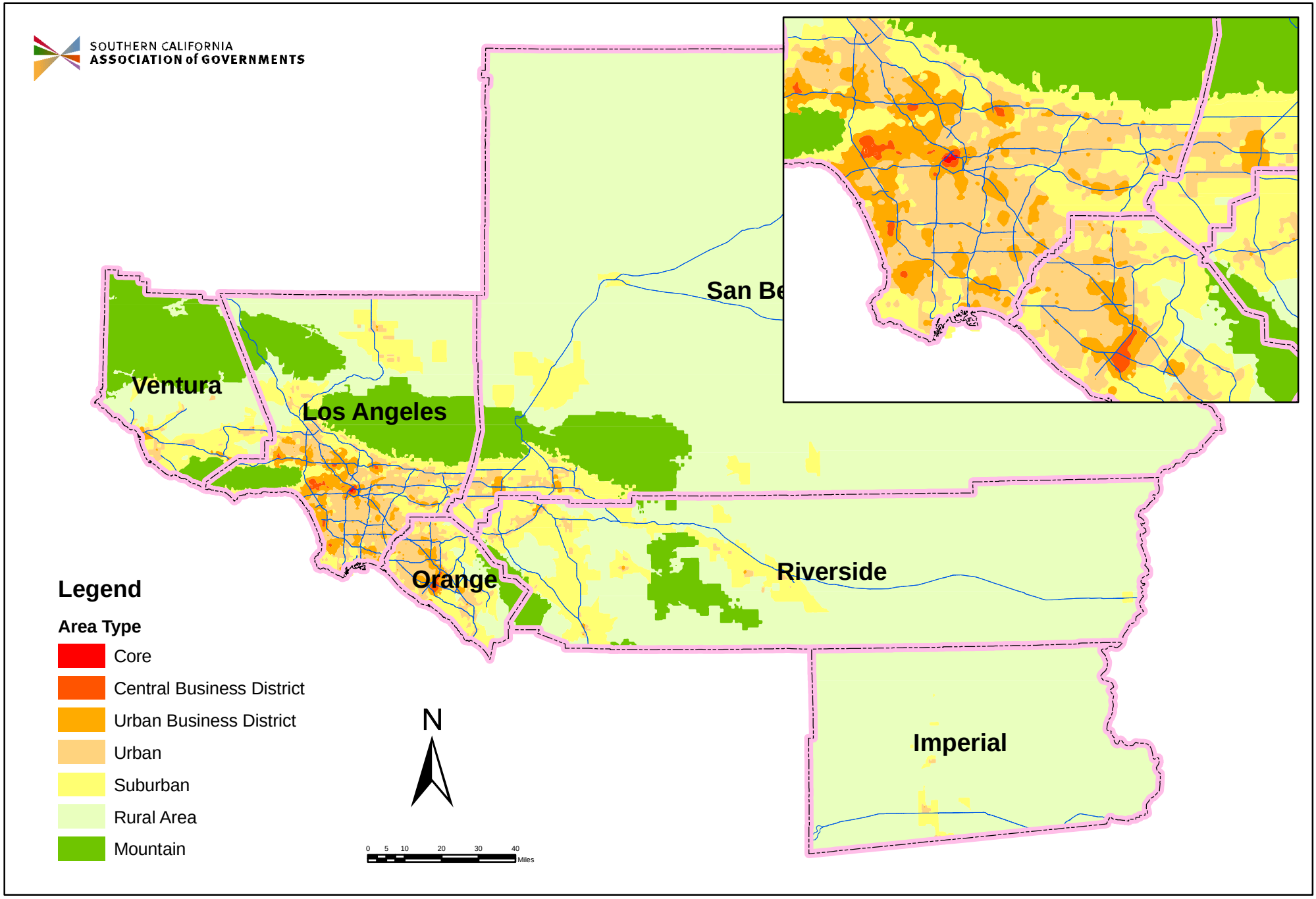

FIGURE 4-2
YEAR 2003 MODELING AREA BY AREA TYPE

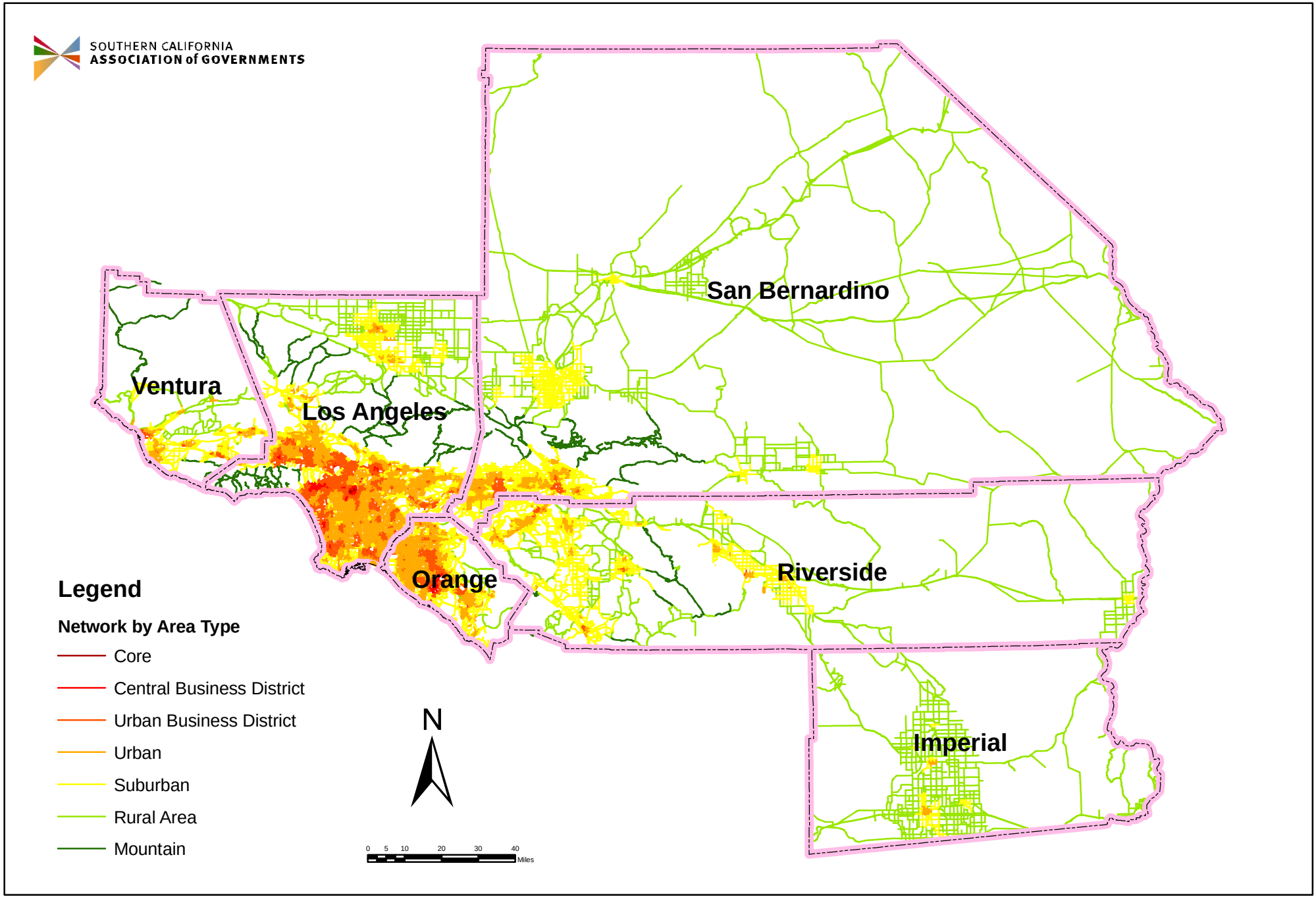

FIGURE 4-3
YEAR 2003 NETWORK BY AREA TYPE

Table 4-7

YEAR 2003 HIGHWAY NETWORK SUMMARY

AM PEAK PERIOD

FACILITY	COUNTY						TOTAL
	Imperial	Los Angeles	Orange	Riverside	San Bernardino	Ventura	
FREEWAY:							
Centerline Miles	93	536	143	300	447	91	1,610
Lane Miles (AM Peak Period)	375	4,240	1,161	1,651	2,226	509	10,162
Lane Miles (Midday Period)	375	4,240	1,161	1,651	2,226	509	10,162
Lane Miles (PM Peak Period)	375	4,240	1,161	1,651	2,226	509	10,162
Lane Miles (Night Period)	375	4,240	1,161	1,651	2,226	509	10,162
MAJOR ARTERIAL:							
Centerline Miles	89	2,290	664	355	579	266	4,243
Lane Miles (AM Peak Period)	329	8,656	3,136	1,315	1,821	883	16,140
Lane Miles (Midday Period)	329	8,562	3,135	1,315	1,821	883	16,045
Lane Miles (PM Peak Period)	329	8,677	3,135	1,315	1,821	883	16,160
Lane Miles (Night Period)	329	8,565	3,135	1,315	1,821	883	16,048
MINOR ARTERIAL:							
Centerline Miles	343	2,951	871	1,103	1,591	356	7,215
Lane Miles (AM Peak Period)	673	9,226	3,130	3,293	4,289	983	21,594
Lane Miles (Midday Period)	673	9,171	3,133	3,293	4,289	983	21,542
Lane Miles (PM Peak Period)	673	9,218	3,130	3,293	4,289	983	21,586
Lane Miles (Night Period)	673	9,166	3,130	3,293	4,289	983	21,534
COLLECTOR							
Centerline Miles	1,175	1,497	150	1,479	2,699	267	7,267
Lane Miles (AM Peak Period)	2,374	3,359	449	3,612	5,977	623	16,394
Lane Miles (Midday Period)	2,374	3,359	449	3,612	5,977	623	16,394
Lane Miles (PM Peak Period)	2,374	3,359	449	3,612	5,977	623	16,394
Lane Miles (Night Period)	2,374	3,359	449	3,612	5,977	623	16,394
HOV							
Centerline Miles	0	201	93	26	39	0	359
Lane Miles (AM Peak Period)	0	415	191	54	78	0	738
Lane Miles (Midday Period)	0	415	191	54	78	0	738
Lane Miles (PM Peak Period)	0	415	191	54	78	0	738
Lane Miles (Night Period)	0	415	191	54	78	0	738
TOTALS							
Centerline Miles	**1,700**	**7,475**	**1,921**	**3,263**	**5,355**	**980**	**20,335**
Lane Miles (AM Peak Period)	**3,751**	**25,896**	**8,067**	**9,925**	**14,391**	**2,998**	**64,649**
Lane Miles (Midday Period)	**3,751**	**25,747**	**8,069**	**9,925**	**14,391**	**2,998**	**64,881**
Lane Miles (PM Peak Period)	**3,751**	**25,909**	**8,066**	**9,925**	**14,391**	**2,998**	**65,040**
Lane Miles (Night Period)	**3,751**	**25,745**	**8,066**	**9,925**	**14,391**	**2,998**	**64,876**

TRANSIT NETWORKS

Consistent with the Regional Model highway networks, the Year 2003 transit networks cover the entire SCAG Region, with approximately 1600 transit routes for more than 40 transit carriers. Separate transit networks are initially developed for A.M. peak period (6:00 A.M. to 9:00 A.M.) and mid-day period (9:00 A.M. to 3:00 P.M.), based on the transit service information contained in TranStar itinerary database for the year 2000, and then updated to Year 2003 condition. Through common geography and link attributes, these transit networks are related to the highway networks of the same duration to maintain consistency in level-of-service estimation. For the Year 2003 modeling purpose, transit services in the SCAG region are grouped into twelve transit modes and four non-transit modes, according to their service characteristics and fare structures. Additional modes, such as High Speed Rail and special shuttle services, will be added to future year transit networks. The Year 2003 transit network covers only the fixed-route transit services. It does not include dial-a-ride, charter services, airport shuttles and limousines, and taxicabs. Transit routes in each transit network are characterized by attributes such as route ID, route name, route head sign, peak headway, off-peak headway, transit operator, route distance, direction, and transit types. Stops are also placed along the route with information such as route ID, stop coordinates, milepost, and corresponding highway node ID. For rail transit, station-to-station rail time, rail station information, and Metrolink's fare zone are also coded in the network.

Transit Modes

The following is a list of transit modes included in the Year 2003 transit networks:

- Mode 10: Commuter Rail
  - Metrolink
  - Amtrak
- Mode 11: MTA Local Bus
- Mode 12: MTA Express Bus
- Mode 13: MTA Urban Rail (subway and light rail)
- Mode 14: LA County non-MTA Express Bus
  - Antelope Valley Transit Authority
  - Foothill Transit
  - LADOT Commuter Express
  - Santa Clarita Transit
  - Montebello Bus Lines
- Mode 15: LA County non-MTA Local Bus (Fare 1)
  - Antelope Valley Transit Authority
  - Foothill Transit
  - Montebello Bus Lines
  - Palos Verdes Peninsula Transit Authority
- Mode 16: LA County non-MTA Local Bus (Fare 2)
  - Carson Circuit
  - Culver City Transit

    - El Monte Transit
    - Gardena Transit
    - Long Beach Transit
    - Norwalk Transit
    - Santa Clarita Transit
    - Santa Monica Big Blue Bus
    - Torrance Transit
    - Whittier Transit
- Mode 17: LA County non-MTA Local Bus (Fare 3)
    - Alhambra Community Transit
    - Cerritos on Wheels
    - Glendale Beeline
    - LADOT Dash
    - West Covina
- Mode 18: LA County non-MTA Local Bus (Fare 4)
    - Commerce Municipal Bus
    - Santa Fe Springs
- Mode 19: All Other County Local Bus
    - Imperial Valley Transit
    - Omnitrans
    - Orange County Transit Authority
    - Riverside Transit Agency
    - South Coast Area Transit
    - Sunline Transit
    - Victor Valley Transit Authority
- Mode 20: All Other County Express Bus
    - Orange County Transit Authority
    - Riverside Transit Agency
- Mode 22: MTA Rapid Bus

Non-Transit Modes

There are four types of transit access links coded in the Year 2003 transit networks, as defined here:

- Mode 1: Auto and shuttle access links, coded as one-way links from a zone centroid to a park-and-ride lot.
- Mode 2: Walk access, egress, and transfer links, coded as two-way links between a zone centroid and a transit stop location.
- Mode 3: Auto and shuttle egress links from commuter rail stations, coded as one-way links from a park-and-ride lot to a zone centroid.
- Mode 4: Park-and-ride lot to transit links, coded as two-way walk links between a park-and-ride lot and a transit stop location.

Transit Fares

The Year 2003 model includes three types of transit fares: boarding fare, zones fares, and transfer fare. These fares are estimated from the boarding and revenue data provided by transit operators in the SCAG region. All boarding fares are calculated as a weighted average of Year 2003 fare rates in 1999 dollars, considering the revenue composition of different fare types such as monthly passes, weekly passes, senior and disabled citizen discount, student fares, etc. Table 4-8 shows the weighted average boarding fare for each mode in the 2003 transit networks. Fares for Mode 10 (Metrolink commuter rail) are included as a station-to-station fare matrix and thus not listed here.

Transit zone fares are implemented through the use of fare links. For example, a fare link table is developed for Mode 12 (MTA Express Bus) to simulate the additional "add fare" charge of $0.25 on freeway routes such as Harbor Transitway, El Monte Busway, I-10, and I-605. The transit transfer fares assumed for the Year 2003 Model are shown in Table 4-9.

Table 4-8

YEAR 2003 TRANSIT BOARDING FARE BY MODE

TRANSIT MODE	DESCRIPTION	BOARDING FARE
11	MTA Local Bus	$0.75
12	MTA Express Bus	$0.75
13	Urban Rail (MTA Metrorail)	$0.75
14	Los Angeles County Express Bus	$1.03
15	Los Angeles County Local Bus (Group 1)	$0.69
16	Los Angeles County Local Bus (Group 2)	$0.40
17	Los Angeles County Local Bus (Group 3)	$0.19
18	Los Angeles County Local Bus (Group 4)	$0.00
19	All Other Local Bus	$0.75
20	All Other Express Bus	$0.75
22	MTA Rapid Bus	$0.75

Note: Transit boarding fares are in 1999 constant dollars.

Transit Network Summary

Table 4-10 summarizes the number of transit patterns/routes represented in the peak and off-peak transit networks, by "transit mode" as defined above.

Table 4-9

YEAR 2003 TRANSIT TRANSFER FARE BY MODE

TRANSIT MODE (From/To)	DESCRIPTION	10	11	12	13	14	15	16	17	18	19	20	22
10	**Commute Rail**	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
11	**MTA Local Bus**	$2.96	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25	$0.00	$0.75	$0.75	$0.25
12	**MTA Express Bus**	$2.96	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25	$0.00	$0.75	$0.75	$0.25
13	**Urban Rail (MTA Metrorail)**	$2.96	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25	$0.00	$0.75	$0.75	$0.25
14	**Los Angeles County Express Bus**	$2.96	$0.25	$0.25	$0.25	$0.00	$0.69	$0.40	$0.19	$0.00	$0.75	$0.75	$0.25
15	**Los Angeles County Local Bus (Group 1)**	$2.96	$0.25	$0.25	$0.25	$0.69	$0.25	$0.40	$0.19	$0.00	$0.75	$0.75	$0.25
16	**Los Angeles County Local Bus (Group 2)**	$2.96	$0.25	$0.25	$0.25	$0.69	$0.69	$0.19	$0.19	$0.00	$0.75	$0.75	$0.25
17	**Los Angeles County Local Bus (Group 3)**	$2.96	$0.25	$0.25	$0.25	$0.69	$0.69	$0.40	$0.00	$0.00	$0.75	$0.75	$0.25
18	**Los Angeles County Local Bus (Group 4)**	$2.96	$0.75	$0.75	$0.75	$0.69	$0.69	$0.40	$0.19	$0.00	$0.75	$0.75	$0.75
19	**All Other Local Bus**	$2.96	$0.75	$0.75	$0.75	$0.69	$0.69	$0.40	$0.19	$0.00	$0.25	$0.75	$0.25
20	**All Other Express Bus**	$2.96	$0.75	$0.75	$0.75	$0.69	$0.69	$0.40	$0.19	$0.00	$0.75	$0.25	$0.25
22	**MTA Rapid Bus**	$2.96	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25	$0.25	$0.00	$0.75	$0.75	$0.25

Note: Transit boarding fares are in 1999 constant dollars.

Table 4-10

YEAR 2003 TRANSIT NETWORK ROUTE PATTERNS, ROUTE MILES, AND SERVICE MILES

TRANSIT MODE NUMBER	DESCRIPTION	ROUTES PATTERNS		ROADWAY ROUTE MILES		DAILY SERVICE MILES	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
10	**Commuter Rail**	30	19	1,711	1,201	7,831	3,473
11	**MTA Local Bus**	377	393	6,430	6,488	129,851	132,360
12	**MTA Express Bus**	37	25	990	747	18,500	13,597
13	**Urban Rail (MTA Metrorail)**	12	10	187	150	8,428	7,368
14	**Los Angeles County Express Bus**	100	65	2,805	1,881	29,182	14,094
15	**Los Angeles County Local Bus (Group 1)**	76	73	1,217	1,153	12,120	15,425
16	**Los Angeles County Local Bus (Group 2)**	226	217	2,581	2,508	31,631	38,679
17	**Los Angeles County Local Bus (Group 3)**	57	54	473	455	13,902	18,382
18	**Los Angeles County Local Bus (Group 4)**	4	4	54	42	326	408
19	**All Other Local Bus**	418	383	7,093	6,601	72,411	82,165
20	**All Other Express Bus**	14	10	246	139	1,484	731
22	**MTA Rapid Bus**	12	12	193	193	9,316	8,448
TOTAL		**1,363**	**1,265**	**23,981**	**21,558**	**334,982**	**335,130**